Plug-In Hybrid Vehicles for the future of Calif. Transportation Energy Use UCDavis HEV Center

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Hybrid gasoline-electric cars—But **Two** kinds of Hybrid's

- Today's car company hybrids that don't use electricity from the wall and use only gasoline.— Better mileage-HEV-0.
- **Plug-In Hybrids** that use **electricity** from the wall and much **less gasoline**. ---- Much better fuel economy—(2X), and better performance. Engine down sized for the steepest road conditions in the country. Battery sized for 20 to 60 mi All Elect. Range (AER).
- PHEV20 and PHEV60 data presented

How do we reduce Gasoline Consumption?

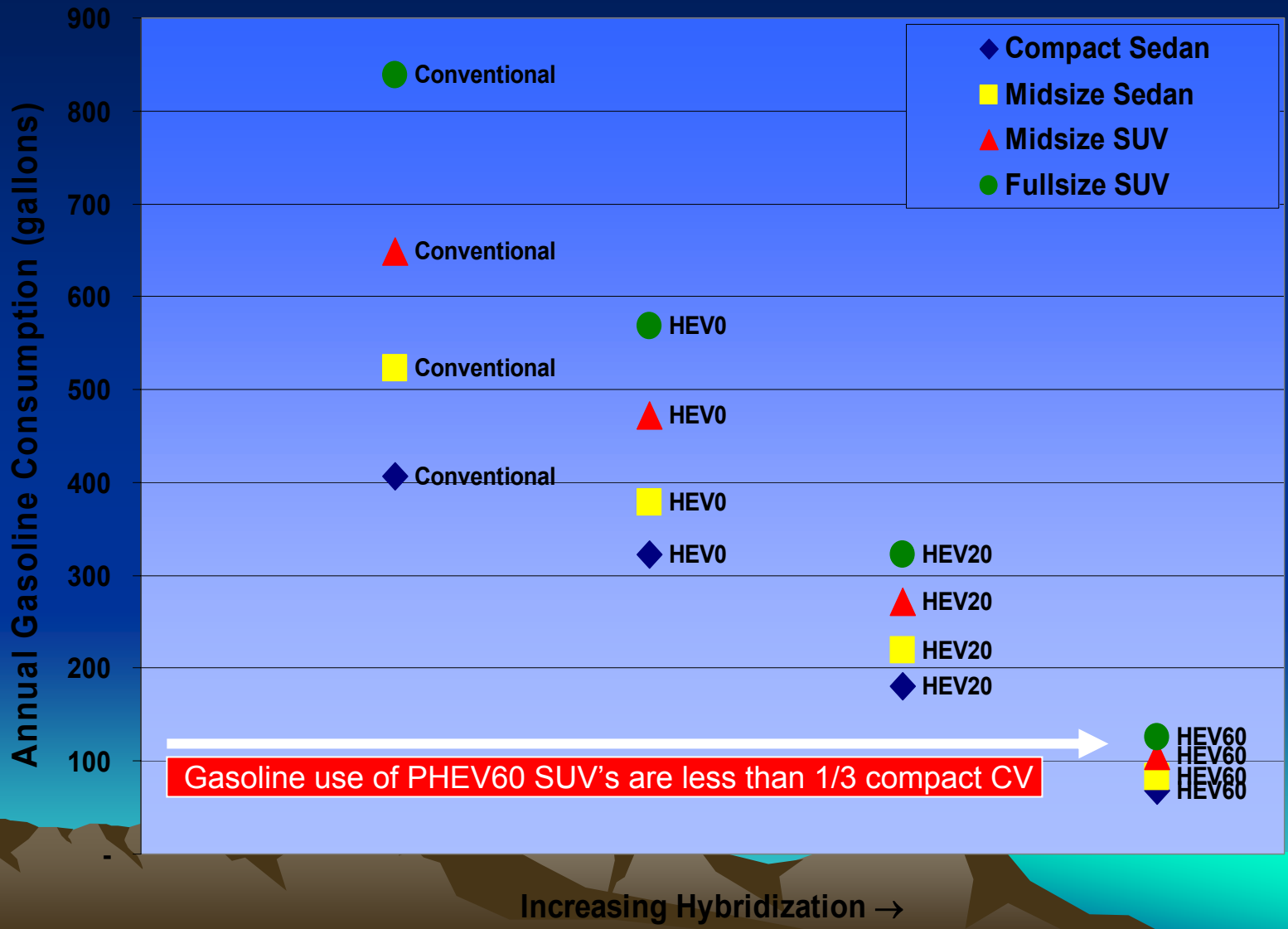
- Design the car for full performance at all times but use electricity for low speeds to 60 mph. This means city driving is ZEV!
- Drive All Electrically until batteries deplete to a certain level~20%, then maintain SOC. Thus, wall electric power is used automatically.
- Charge every night to full or nearly full.
- Use gasoline as a Prius only after 20 to 60 miles of electric ZEV driving per day.
- Design for lifetime,**150kmile**, battery life.
- Design for the way people use their cars.

Use ***Annual Liquid Fuel Consumption*** rather than ***Fuel Economy*** for **Analysis** of PHEV's compared with Conv. Vehicles

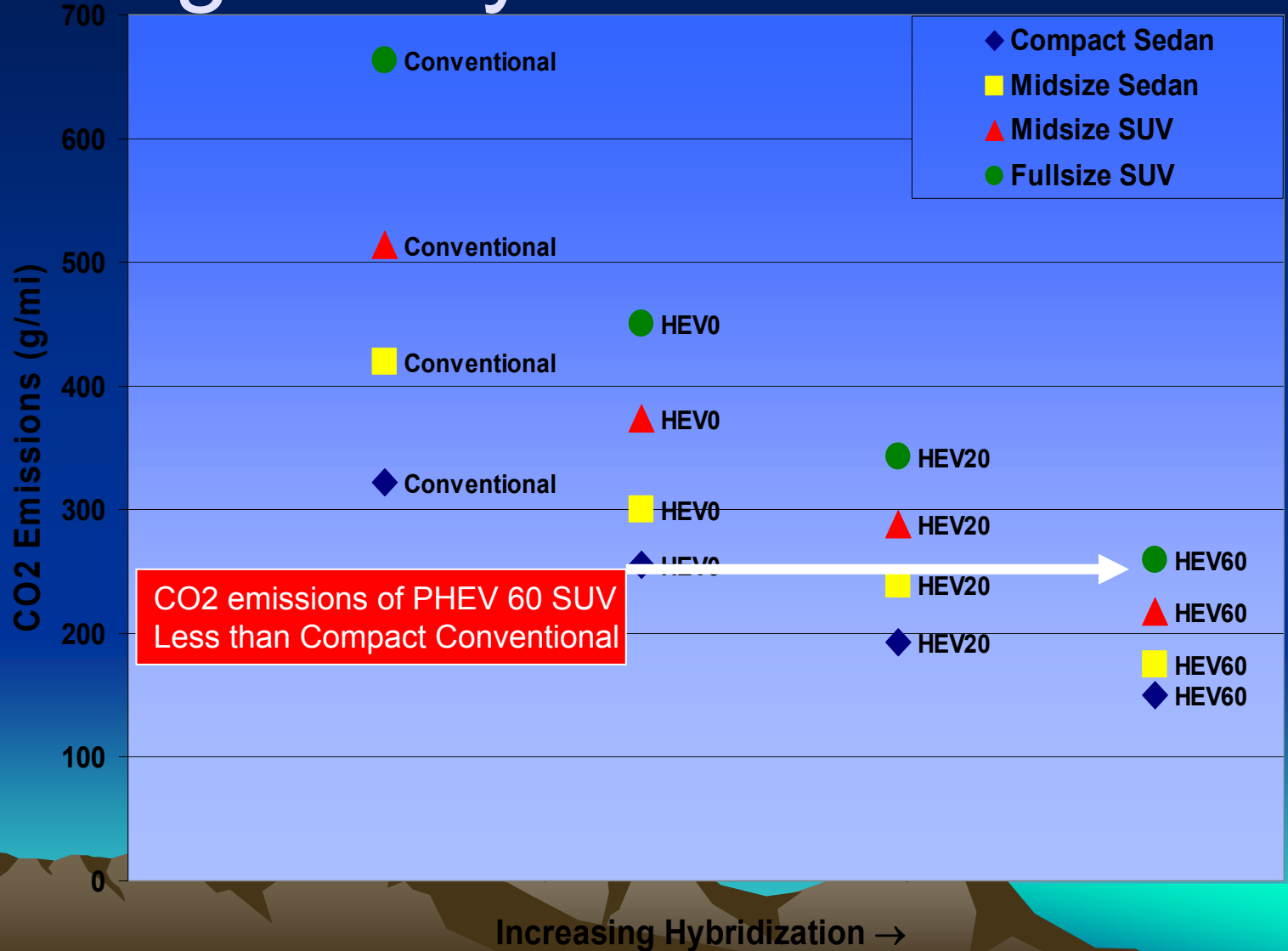
- Allows analysis of dual fuels such as electricity from the wall and gasoline.
- For cars less than 5000 lbs charging is 110v or 220v standard garage GFI plugs nightly.
- Cost of driving is ¼ of conventional gasoline vehicles.
- 60 mi PHEV can reduce gasoline consumption to 10% of conventional cars in annual use.
- 20 mi PHEV reduces annual gasoline use to less than ½ of the Conv Veh.

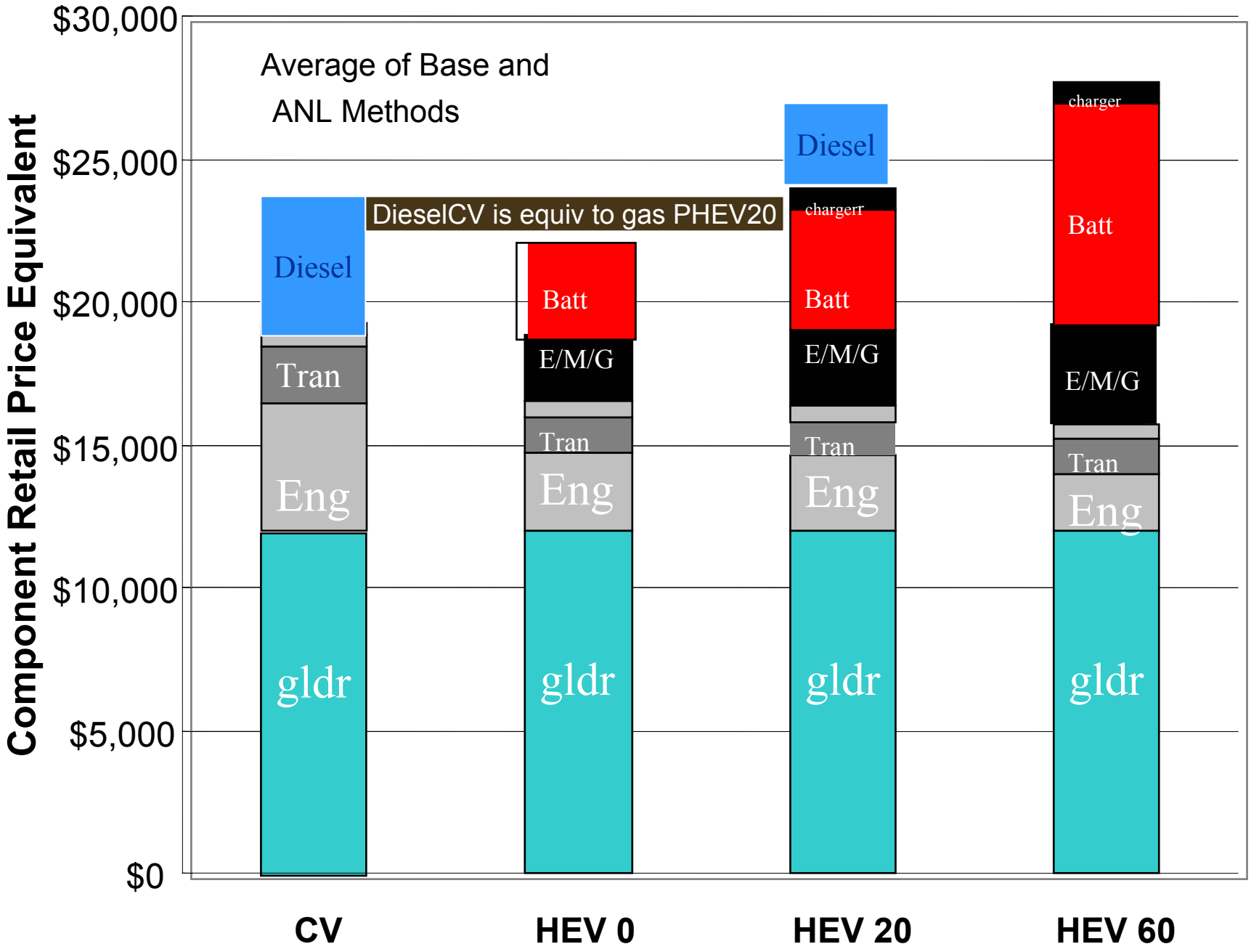
3 of 8, 60 mile AER PI-HEV vehicles constructed at UCDavis-'Please Come and see them for a ride and drive

Annual Gasoline Consumption for 12,000 miles of driving for **all** L/D vehicles



Greenhouse Gas Emissions for all light duty cars trucks




Component Retail Price Equivalent
$30,000
$25,000
$20,000
$15,000
$10,000
$5,000
$0
Average of Base and
ANL Methods
DieselCV is equiv to gas PHEV20
Diesel
Tran
Eng
gldr
Batt
E/M/G
Tran
Eng
gldr
Diesel
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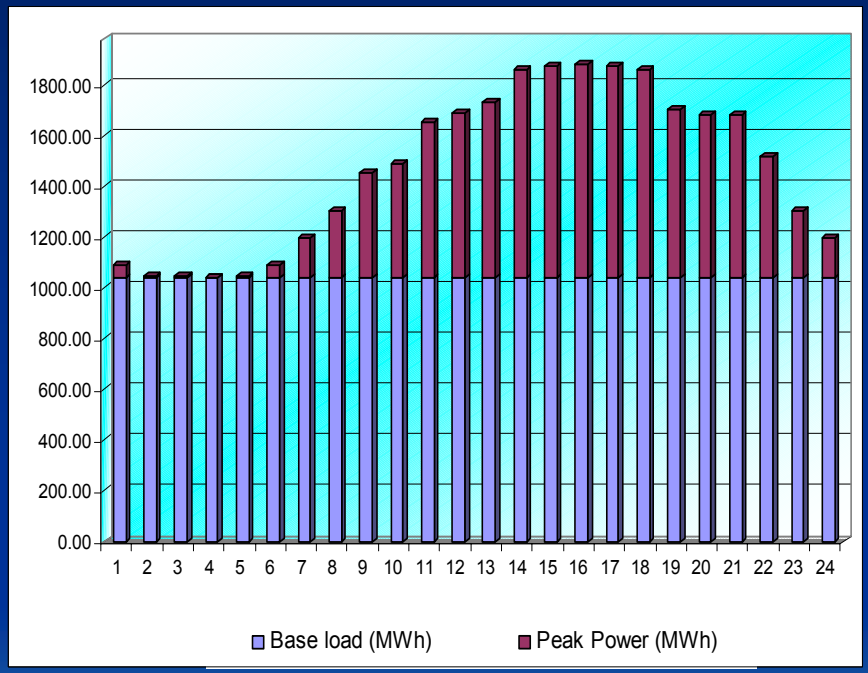
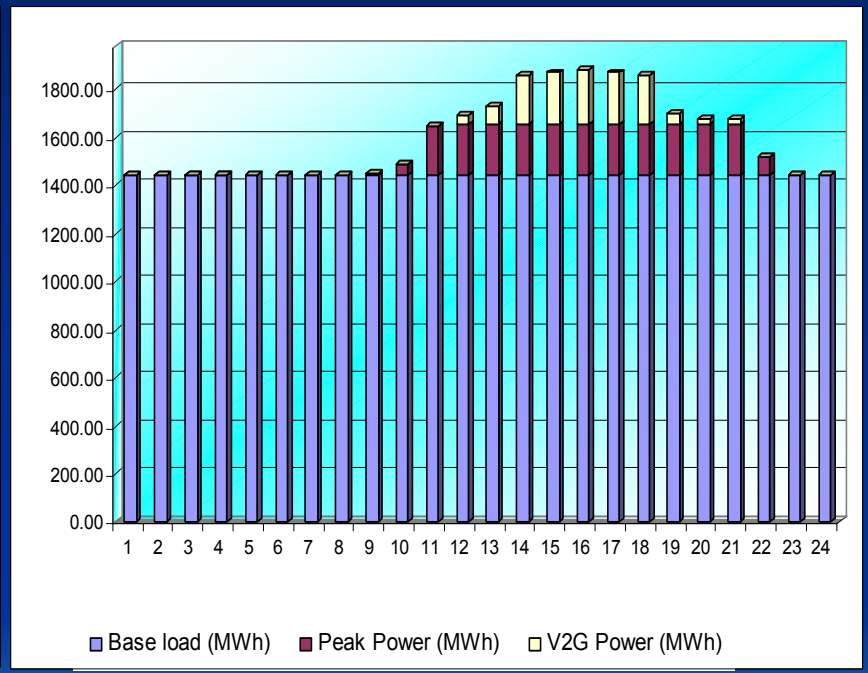
Batt
E/M/G
Tran
Eng
gldr
CV
HEV 0
HEV 20
HEV 60

The PHEV can be used to balance the Electric Grid-***Integrating*** stationary and transportation energy sectors---20% PHEV penetration in Sacramento.





Energy available for the grid (V2G)	**0**	Mwh	Consumption without V2G	**35300**	Mwh	Total Base load before	**24960**	Mwh	Total Peak Power before	**10340**	Mwh
Energy use for recharging vehicles	**4**	Mwh	Consumption with V2G	**37068**	Mwh	Total Base load after	**34560**	Mwh	Total Peak Power after	**2508**	Mwh
Nb of vehicles	**125000**	#	Consumption increase	**5.01**	%	Base load increase	**38.46**	%	Peak Power decrease	**75.74**	%

Result of 20% penetration of PHEV's over the next 10 to 20 years.

- No more power generation is needed in Calif.
- No change of electrical infrastructure needed.
- Less peak power needs to be generated.
- More efficient electrical system.
- Lower cost electricity to everyone!!
- At new car penetration of 2%/year of 60 mi PHEV's. ---**20%** penetration will take at least 10 years into future if PHEV's are manufactured today!!
- No new technology or manufacturing infrastructure is needed to start PHEV's now!!

Conclusions

- PHEV's can best solve the upcoming petroleum crisis and CO2 emissions today at a small incremental cost from today's cars and trucks.
- Renewable electric energy- *Solar and Wind* -are perfect for the PHEV and **much more** efficient than other concepts now being explored.
- Gasoline use in PHEV's can be entirely replaced by ethanol with **no impact** on current volume of ethanol production!! Also leads to future fuels!!
- Need regulations to encourage and reward OEM's and the public for being the first adopters.

Some possible *no cost* incentives to encourage the Car companies to build PHEV's

- Provide credits proportional to ZEV range above 20 mi before the engine sustains the batteries.
- Provide credits for PHEV's manufactured in the USA.
- Driving perks such as use of HOV lanes.
- Parking perks such as use of handicap spots if unused, and no coins required in meters for the first hour, free parking in public ramps, etc.
- Tax credits for use of ethanol with submission of receipts.
- Objective is to provide payback for incremental costs in **less than 2 years!!**